CHAPTER 4 WELDING ON BOILERS AND UNFIRED PRESSURE VESSELS

400 RULES FOR WELDING

400.1 The construction, installation, repair or alteration of a boiler or unfired pressure vessel by welding shall be made in accordance with the section of the A.S.M.E. Code governing the particular kind of vessel or work to be done or by the specific requirements in this section for welded repairs.

400.2 A contractor desiring to make repairs shall have a written welding procedure specification that shall be prepared and qualified in accordance with the Welding Qualification of the A.S.M.E. Code or the contractor may use the standard D.C. welding procedure specification. This procedure shall then be used for qualifying each welders and shall be strictly adhered to in making repairs under this chapter. A welder shall be limited to the type of steel and thickness of plate for which he or she was qualified.

400.3 Each welder shall pass satisfactory qualification tests as required by the A.S.M.E. Code.

400.4 The qualification test for individual welders shall be made in accordance with the A.S.M.E. Code. The test shall be made in the presence of the boiler inspector or an assistant boiler inspector who shall stamp the specimens with a D.C. identifying number. A welder may be accepted without further examination provided that he submits a satisfactory welding procedure and operator qualification test, made in accordance with the A.S.M.E. Code and these regulations, for approval prior to any welding.

400.5 After the specimens have been prepared as required by the A.S.M.E. Code, they shall be tested by the D.C. Boiler Inspector or they may be submitted to the National Bureau of Standards for test. The test shall be made in accordance with the guided-bend jig test as described in the A.S.M.E. Code. A report shall be made on a form similar to Form Q-1 in the A.S.M.E. Code.

400.6 The fee for witnessing the welding and making the tests shall be twenty-five dollars ($25). The fee for the Bureau of Standards test is additional. All fees are payable in advance.

400.7 If the report indicates that the welder has passed the test, a card authorizing him or her to do welding on boilers or unfired pressure vessels in the District of Columbia for a period of two (2) years from the date of the test, shall be issued.

400.8 The qualification test does not qualify a welder to do welding on pressure piping.

400.9 A welder who fails to meet the requirements for one or more of the test specimens may be retested under the following conditions:

(a) When an immediate retest is made, the welder shall make two test welds of each type for each position on which he has failed, all of which shall pass the test examination; or

(b) If, in the judgment of the inspector, the welder requires further taining or practice, a complete retest of the welder shall be made after he has completed his additional training or practice.

400.10 Notwithstanding the issuance of a qualification card, the inspector may request a new test under the following circumstances:

(a) When a welder has not welded under the procedure specification for a period of three (3) months or more;

(b) When there is a specific reason to question his ability to make welds that meet the specification; and

(c) At the expiration of his two (2) year qualification period.

400.11 If any question should arise as to the quality of a weld, the inspector may call for test specimens to be trepanned from the welds. Preparation of the specimens and examination shall be done by the National Bureau of Standards and the contractor shall stand all expense incidental to this testing.

400.12 No welding on any boiler or unfired pressure vessel shall be done before an inspection has been made by the boiler inspector, an assistant boiler inspector, or an insurance company inspector, and the method of welding sanctioned by that inspector. If, in the opinion of the inspector, a hydrostatic test is necessary, that test shall be applied after the repairs have been completed.

400.13 Before repairs are started, it shall be the duty of the inspector to satisfy himself or herself, by examination of the written welding procedure and records of qualification tests, that procedures and welders have been properly tested and qualified.

400.14 Welding repairs or alterations on boilers or unfired pressure vessels and connections by unqualified contractors or welding operators will not be accepted for either new or existing installations.

400.15 A report shall be made or every welded repair by the inspector who authorized and witnessed the repair.

§§401 - 403 RESERVED

404 METHOD OF CONDUCTING TESTS

404.1 The qualification tests described in this section shall be specially devised tests to determine a welder's ability to produce sound welds. In order to determine the welder's ability to make groove welds in various positions in plate, the following three positions for tests are required:

(a) **Test Position I** - Plates placed in a vertical position with the welding groove in a horizontal plane. This test shall qualify the welder to make flat and horizontal welds.

(b) **Test Position II** - Plates placed in a vertical position with the axis of the weld vertical. The test shall qualify the welder to make flat and vertical welds.

(c) **Test Position III** - Plates placed in a horizontal position with the weld metal deposited from the underside of the plate. This test shall qualify the welder to make flat welds in the overhead position.

404.2 The base material of the plates to be welded shall be of flange or fire box steel quality three-eighths inch (3/8") thick and having a tensile strength of not less than fifty-five thousand (55,000) lb. square inch. The plates shall be five inches (5") long by six inches (6") wide, and shall be prepared for a single "V" groove butt joint in accordance with prepared Fig. 1 for arc welding or Fig. 2 for oxygen-acetylene welding.

404.3 The method of preparing test specimens shall be as follows:

(a) When the welding has been completed, specimens shall be removed as directed by machine or flame cutting. They shall be approximately one and one-half inches (1 1/2") wide.

(b) The weld reinforcement shall be removed by machine or grinding, flush with the surface or the base metal.

400.7 If the report indicates that the welder has passed the test, a card authorizing him or her to do welding on boilers or unfired pressure vessels in the District of Columbia for a period of two (2) years from the date of the test, shall be issued.

400.8 The qualification test does not qualify a welder to do welding on pressure piping.

400.9 A welder who fails to meet the requirements for one or more of the test specimens may be retested under the following conditions:

(a) When an immediate retest is made, the welder shall make two test welds of each type for each position on which he has failed, all of which shall pass the test examination; or

(b) If, in the judgment of the inspector, the welder requires further taining or practice, a complete retest of the welder shall be made after he has completed his additional training or practice.

400.10 Notwithstanding the issuance of a qualification card, the inspector may request a new test under the following circumstances:

(a) When a welder has not welded under the procedure specification for a period of three (3) months or more;

(b) When there is a specific reason to question his ability to make welds that meet the specification; and

(c) At the expiration of his two (2) year qualification period.

400.11 If any question should arise as to the quality of a weld, the inspector may call for test specimens to be trepanned from the welds. Preparation of the specimens and examination shall be done by the National Bureau of Standards and the contractor shall stand all expense incidental to this testing.

400.12 No welding on any boiler or unfired pressure vessel shall be done before an inspection has been made by the boiler inspector, an assistant boiler inspector, or an insurance company inspector, and the method of welding sanctioned by that inspector. If, in the opinion of the inspector, a hydrostatic test is necessary, that test shall be applied after the repairs have been completed.

400.13 Before repairs are started, it shall be the duty of the inspector to satisfy himself or herself, by examination of the written welding procedure and records of qualification tests, that procedures and welders have been properly tested and qualified.

400.14 Welding repairs or alterations on boilers or unfired pressure vessels and connections by unqualified contractors or welding operators will not be accepted for either new or existing installations.

400.15 A report shall be made or every welded repair by the inspector who authorized and witnessed the repair.

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404.1 The qualification tests described in this section shall be specially devised tests to determine a welder's ability to produce sound welds. In order to determine the welder's ability to make groove welds in various positions in plate, the following three positions for tests are required:

(a) **Test Position I** - Plates placed in a vertical position with the welding groove in a horizontal plane. This test shall qualify the welder to make flat and horizontal welds.

(b) **Test Position II** - Plates placed in a vertical position with the axis of the weld vertical. The test shall qualify the welder to make flat and vertical welds.

(c) **Test Position III** - Plates placed in a horizontal position with the weld metal deposited from the underside of the plate. This test shall qualify the welder to make flat welds in the overhead position.

404.2 The base material of the plates to be welded shall be of flange or fire box steel quality three-eighths inch (3/8") thick and having a tensile strength of not less than fifty-five thousand (55,000) lb. square inch. The plates shall be five inches (5") long by six inches (6") wide, and shall be prepared for a single "V" groove butt joint in accordance with prepared Fig. 1 for arc welding or Fig. 2 for oxygen-acetylene welding.

404.3 The method of preparing test specimens shall be as follows:

(a) When the welding has been completed, specimens shall be removed as directed by machine or flame cutting. They shall be approximately one and one-half inches (1 1/2") wide.

(b) The weld reinforcement shall be removed by machine or grinding, flush with the surface or the base metal.

404 METHOD OF CONDUCTING TESTS (Continued)

404.3 (Continued)

(c) The corners of the edges of all test specimens shall be rounded to a radius of not more than one-fifteenth inch (1/15").

(d) Specimens 1, 3 and 5 shall be tested as face bend specimens; 2, 4 and 6 as root bend specimens.

404.4 The method of testing specimens shall be as follows:

(a) Specimens shall be bent in a bending jig called the guided bend test, until the curvature of the specimen is such that a one-thirty-second inch (1/32") wire cannot be passed between the curve portion of the plunger and the specimen. Face bend specimens shall be placed with the face of the weld toward the gap in the jig; root bend specimens shall be placed with the root of the weld toward the gap.

(b) After removal from the jig, the convex surface of the specimens shall be examined for the appearance of cracks or other open defects. Any specimen in which a crack or other open defect is present after the bending exceeding one-eighth inch (1/8") measured in any direction, shall be cause for failure to pass the test.

405 REPAIRS BY WELDING

405.1 The repairs that may be made under these rules are limited to steels having known weldable quality and are further limited to carbon steels having a carbon content of not more than thirty-five hundredths percent (0.35%) and low alloy steels having a carbon content of not more than twenty-five hundredths (0.25%) percent.

405.2 A welder shall not make repairs in a plate thickness in excess that permitted under the qualification tests in the A.S.M.E. Code or on a material or in a thickness of plate that is not permitted within his qualification tests.

405.3 Groove welds shall completely penetrate the material being welded. If possible, welding shall be applied from both sides of the plate, or a backing strip or ring may be used to insure complete penetration. Welds shall have a convex surface on both sides if applied on both sides of the plates being joined; or on one side if welding is applied from one side only. No valleys or undercutting at edges or welded joints shall be permitted. The reinforcement may be chipped, ground or machined off flush with the base metal, if so desired, after the welding has been completed.

405.4 In making a repair to a weld that has failed in service, the defective weld material shall be removed by chipping or grinding until sound metal is reached on all sides. The resulting groove shall be filled as required by the applicable welding procedure.

405.5 In the repair of carbon or low alloy steels, when required by these rules and when considered necessary by the authorized inspector, thermal stress-relieving shall be applied to the completed work. The heat may be applied by any means that will raise the temperature of the material gradually and uniformally to approximately twelve hundred degrees Farenheit (1200° F.). In the absence of more accurate means of determining temperature, a dull red glow in daylight will suffice. This temperature shall be maintained for a period of one hour per inch of thickness of material.

405.6 For circumferential joints, the area heated shall comprise a band extending completely around the cylinder and having a width on each side of the center line of the weld not less than three times the greatest width of the finished weld.

405.7 For nozzles, the heated area shall comprise a circumferential band extending around the entire vessel, including the nozzle of welded attachment, and shall extend at least six times the plate thickness beyond the welding which connects the nozzle or other attachment to the vessel.

405.8 It should be noted that under certain conditions, thermal stress relieving as outlined above may be inadvisable. In such cases any other method of stress-relieving acceptable to the authorized inspector may be used. Under certain conditions preheating may be necessary.

405.9 Upon completion of the stress-relieving operation, the plate shall be allowed to cool at a rate not greater than five hundred degrees Farenheit (500° F.) per hour divided by the maximum thickness of the welded part in inches, but in no case more than five hundred degrees Farenheit (500° F.) per hour. This rate of cooling shall be maintained until a temperature of approximately five hundred degrees Farenheit (500° F.) is reached, after which normal cooling by exposure in a still atmosphere may be permitted.

§§406 - 409 RESERVED

410 WELDED REPAIRS ON BOILERS AND UNFIRED PRESSURE VESSELS

410.1 Cracks in stayed areas may be repaired by welding; Provided, that no multiple or star cracks radiating from rivet or stay bolt holes shall be welded.

410.2 Cracks in unstayed shells, drums or headers of boilers or pressure vessels may be repaired by welding; Provided, that the cracks do not extend between rivet holes in a longitude seam or parallel to a longitudinal riveted seam within eight inches (8"), measured from the nearest caulking edge. The total length of any one such crack shall not exceed eight inches (8"). A crack of greater length may be welded provided the complete repair is radiographed and stress-relieved. Any crack that may be welded shall be properly prepared to permit fusion through the entire plate.

410.3 Cracks of any length in unstayed furnaces may be welded; Provided, that the welds are thermally stress relieved. Welds shall be applied from both sides of the plate wherever possible. Welds applied from one side only may be used if expressly permitted by the inspector. Repair of cracks at the knuckle or turn of flange of furnace openings shall be prohibited except upon special approval by the inspector.

410.4 Corroded areas in stayed surfaces may be built up by welding; Provided, that the remaining plate has an average thickness of not less than fifty percent (50%) of the original thickness, and further provided that the areas so affected are not sufficiently extensive to impair the safety of the object. In those cases the stays and stay bolts shall come completely through the reinforcing metal and the original ends of the stay bolts shall be plainly visible to the inspector.

410.5 Corroded areas around manholes or handhole openings, in either stayed or unstayed plates, may be built up by welding; Provided, that the average loss of thickness does not exceed fifty percent (50%) of the original plate thickness and the area to be repaired does not extend more than three inches (3") from the edge of the hole.

410.6 Corroded areas in unstayed shells, drums or headers may be built up by welding provided that in the judgment of the inspector, the strength of the object has not been impaired.

410.7 Edges of butt straps, of plate laps and nozzles, or of connections, attached by riveting may be restored to their original thickness by welding. No seal welding shall be used except upon special approval of the inspector, and in no case where cracks are present in riveted areas.

410.8 The ends of tubes in fire-tube and water-tube boilers may be welded proseal vided they have not been reduced more than ten percent (10%) percent in thickness and comply with the requirements of paragraphs P-250 and P-251 of the A.S.M.E. Power Boiler Code.

410.9 Re-ending of piecing tubes or pipes in either fire-tube or water-tube boilers shall be permitted provided the thickness of the tube or pipe has not been reduced by more than ten percent (10%) from the thickness required by the A.S.M.E. for the pressure approved. In all cases they shall comply with the the requirements of Paragraph P-112 of the A.S.M.E. Power Boiler Code.

410.10 The material used for patches shall be of the same general quality and have at least the minimum physical properties of the plate to be patched. The thickness of any patch shall be at least equal to, but not more than one-third inch (1/3") greater than the plate being patched.

410.11 No flush or butt-welded patches in unstayed shells, drums or headers shall be permitted.

410.12 Flush or butt-welded patches or new sections may be applied to stayed plates without limitation of size or plate thickness.

410.13 Lapped or fillet-welded patches may be applied to stayed plates provided they are not exposed to radiant heat. Lapped and fillet-welded patches may be applied on the pressure side of the sheet in unstayed areas; Provided the maximum diameter of the opening so repaired does not exceed sixteen (16) times the thickness of the plate, but in no case larger than eight inches (8") in diameter.

410.14 Threaded stays may be replaced by welded-in stays; Provided, that in the judgment of the inspector, the plate adjacent to the stay bolt has not been materially weakened by deterioration or wastage. All requirements of the applicable sections of the A.S.M.E. Code governing welded-in stays shall be complied with.

411 PENALTY

411.1 Any contractor or welder, found guilty of doing welding on a boiler or pressure vessel without having a valid card entitling him to do welding in the District of Columbia or of welding on a boiler or unfired pressure vessel without having been authorized to do so by an authorized inspector, shall be subject to the penalty contained in Section 13 of the Act. In addition, he shall be subject to having his card of authorization revoked.